

Acoustical and Intelligibility Test of the Vocera® B3000 Communication Badge

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Introduction

To communicate with each other or ground support, crew members on board the International Space Station (ISS) currently use the Audio Terminal Units (ATU), which are located in each ISS module. However, to use the ATU, crew members must stop their current activity, travel to a panel, and speak into a wall-mounted microphone, or use either a handheld microphone or a Crew Communication Headset that is connected to a panel. These actions unnecessarily may increase task times, lower productivity, create cable management issues, and thus increase crew frustration.

Therefore, the Habitability and Human Factors and Human Interface Branches at the NASA Johnson Space Center (JSC) are currently investigating a commercial-off-the-shelf (COTS) wireless communication system, Vocera®, as a near-term solution for ISS communication. The objectives of the acoustics and intelligibility testing of this system were to answer the following questions:

1. How intelligibly can a human hear the transmitted message from a Vocera® badge in three different noise environments (Baseline = 20 dB, US Lab Module = 58 dB, Russian Module = 70.6 dB)?
2. How accurate is the Vocera® badge at recognizing voice commands in three different noise environments?
3. What body location (chest, upper arm, or shoulder) is optimal for speech intelligibility and voice recognition accuracy of the Vocera® badge on a human in three different noise environments?



Vocera® B3000 badge



MRT Answer Sheet

Methods

Speech Intelligibility Study

Participants

The JSC Human Test Subject Facility provided 7 males and 5 females that were prescreened for normal hearing.

Experimental Design

While utilizing male and female spoken words from the Modified Rhyme Test (MRT), the participants listened and were asked to identify nine words per condition. The conditions included the speakers and listeners in baseline, US, & Russian noise environments, and with the badge at the shoulder, chest, & upper arm locations.

Equipment

Anechoic and space vehicle simulation acoustic chambers at JSC's Acoustics and Noise Control Lab.

Voice Recognition Study

Participants

A total of 10 (Five males and five females) completed the study.

Experimental Design

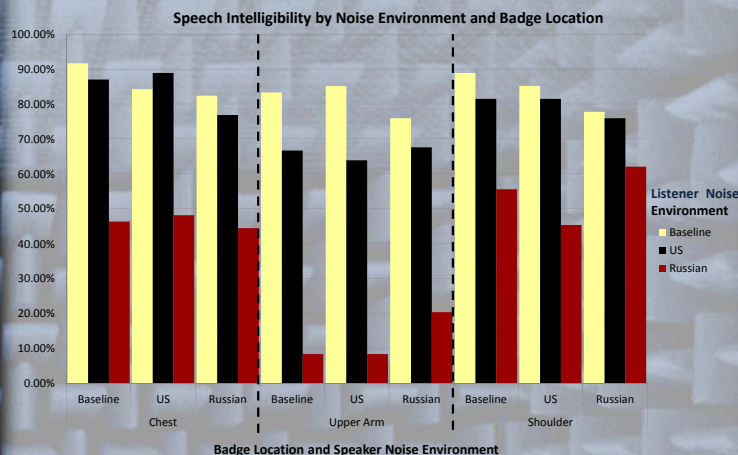
The participants spoke nine commands (e.g., "Call", "Broadcast a message", "Invite", and "Log out") while in the baseline, US, & Russian noise environments, and with the badge at both the shoulder & chest locations.

Equipment

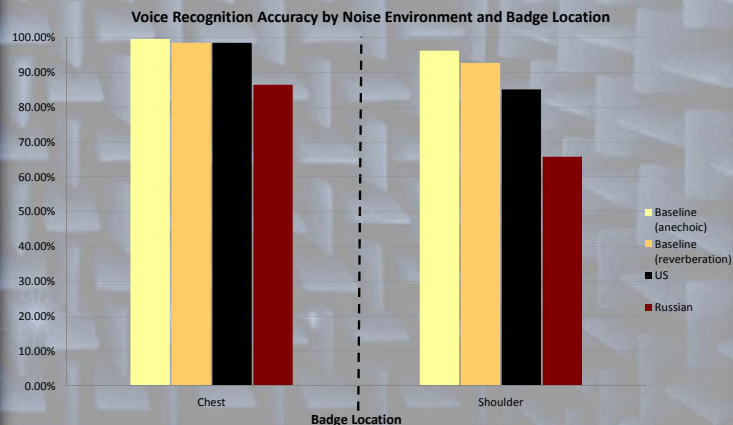
Anechoic and reverberation chambers at JSC's Audio Development Lab.

Results

1. The shoulder and chest locations resulted in higher intelligibility scores. The Russian noise environment had the lowest intelligibility scores (Figure below).



2. The chest was the optimal location for achieving the highest voice recognition accuracy. The US and Baseline noise levels resulted in similar accuracy levels while the Russian noise environment experienced a decrease (Figure below).



3. The participants preferred the shoulder location for their ability to hear, however they preferred the chest location in terms of the comfort and stability of the badge.

Conclusions

Based upon the findings of these studies, the human factors engineers were able to determine the optimal location for the Vocera® B3000 badge to maximize the accuracy of communication for the astronaut using this device while living and working on the ISS. Even though the shoulder provided a slightly preferred location for the user's ability to hear since the speaker was closest to their ears, the intelligibility and voice recognition data demonstrated the best overall performance of the badge's speaker and microphones while at the chest location. Future studies will investigate the use of headsets as well as adding an attachment to the badge which will direct the sound upwards while worn on the chest.